Review Article

Overview of the Shenzhen Emergency Medical Service Call Pattern

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BACKGROUND: In Shenzhen, the Emergency Medical Service (EMS) system has been in service since 1997. This study aims to examine the operation of Shenzhen 120 EMS center and to identify the reasons of calling EMS.

METHODS: In this retrospective quantitative descriptive study, the data from the Shenzhen 120 EMS registry in 2011 were analyzed.

RESULTS: Shenzhen 120 EMS center is a communication command center. When the number of 120 are dialed, it is forwarded to the closest appropriate hospital for ambulance dispatch. In 2011, the Shenzhen 120 EMS center received 153 160 ambulance calls, with an average of 420 calls per day. Calling emergency services was mainly due to traffic accidents. Trauma and other acute diseases constituted a majority of ambulance transports. The adult patients aged 15–60 years are the principal users of EMS. There are no recognized 'paramedic' doctors and nurses. The pre-hospital emergency service is under the operation of emergency departments of hospitals. Shenzhen at present does not have specialized pre-hospital training for doctors and nurses in post-trauma management. Moreover, specialized pre-hospital training, financial support, and public health education on proper use of EMS should be emphasized.

CONCLUSION: The Shenzhen 120 EMS center has its own epidemiology characteristics. Traumatic injury and traffic accident are the main reasons for calling ambulance service. In-depth study emphasizing the distribution and characteristics of trauma patients is crucial to the future development of EMS.

KEY WORDS: Emergency Medical Service System; Shenzhen; Pre-hospital emergency care

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INTRODUCTION

According to the sixth national population census, the total population of the mainland of China reached 1.3397 billion in 2010.^[1] The rapid urbanization and economic growth, together with aging population, aggregate the demand on the health care system. Because of the changing needs, the emergency medical service (EMS) system in China has undergone a significant change since

the 1980s. At the fifth Emergency Medicine Association Council Meeting, the Chinese Medical Association put forward the so-called three links theory: "pre-hospital emergency service, in-hospital emergency resuscitation and intensive care unit" for the uniform EMS System.^[2]

Under the guidance of the health authorities, the pre-hospital emergency services in China have been well developed and divided into the following five models:

Purely pre-hospital emergency services without in-patient beds (Shanghai Model)

In major cities including Shanghai, Tianjin, Nanjing, Wuhan and Hangzhou, their EMS is subordinate to their local public health departments, providing pre-hospital emergency services without in-patient services. In Shanghai, the pre-hospital EMS is provided in 10 sub-centers. Shanghai Emergency Medical Center (SEMC) is one of the most advanced dispatch system in China. In Shanghai, the pre-hospital emergency service system currently has 111 ambulance depots and 500 ambulances, providing a network of urban service radius of 4.5 km.^[3-5]

Independent emergency service center (Beijing Model)

In Beijing and Shenyang, their emergency service centers are independent to hospital emergency departments. The Beijing Emergency Medical Center, which was established in 1988, is expanding with new emergency care unit, with a service radius of 3–5 km.^[4,5]

Pre-hospital emergency service supported by a general hospital (Chongqing Model)

In Chongqing, Chengdu, Qingdao and Haikou, their pre-hospital emergency services are provided by the nearby hospitals, which integrate with the pre- and in-hospital emergency care. The ambulances are staffed by medical workers from the hospitals, indicating the workload of hospital staffs is increased while reducing the efficiency of emergency department.^[4,5]

Unified communication command center (Guangzhou and Shenzhen Model)

Under this model, the 120 emergency calls are centralized in a communication command center. After receiving the call, the center would then forward it to the closest appropriate hospital for ambulance dispatch. It has the advantages of rational utilization of medical resources, shortening the response time and improving the rescue efficiency.^[4,5]

Integrated with fire and police department (Suzhou)

Similar to the practice in Hong Kong, the pre-hospital emergency service is incorporated into the fire and police departments.^[5,6]

In Shenzhen, the EMS center has been developed with the Guangzhou model since 1997. This study presents the function of Shenzhen 120 EMS center and its calling pattern. This study aims to examine the operation of Shenzhen 120 EMS center and to identify

the reasons of calling ambulance service.

METHODS

It is a descriptive study of retrospective data collected from the Shenzhen 120 EMS data registry in 2011. The Shenzhen 120 EMS center was established in 1997. It is a unified communication command center responsible for directing the 120 emergency call to the closest appropriate hospital for ambulance dispatch. The daily 120 calling is included in a record book as data registry. The data captured in the data registry were retrieved. The data of wrong entry were excluded, and the missing data such as unclassified category were also excluded. SPSS version 12.0 was used to examine the basic information such as age group, gender, specialty category, and the reasons for calling ambulance services.

RESULTS

The operation of Shenzhen 120 EMS

The Shenzhen 120 EMS established in 1997 is a unified communication command center responsible for coordination of Shenzhen's pre-hospital emergency service. It is divided into six administrative regions and four economic regions^[7] and serves one of the highest density cities in China with a population of approximately 10 million. It adopts the Guangzhou model with the 120 calling to the closest appropriate hospital for ambulance dispatch. Based on the principle of "call centralization, share responsibility, closest dispatch, closest resuscitation and closest transport specialization",^[8] each hospital in the network takes care of the service radius of 3–5 km.

Ground-based ambulance services are the main transport mode for pre-hospital emergency services in China. In Shenzhen, there are about 150 ambulances among 83 hospitals, of which 70% are monitoring ambulances which are well-equipped with monitoring equipments and instruments for resuscitation of critically ill patients, resembling a mobile intensive care unit.^[8]

In China, pre-hospital medical service is under the operation of emergency department (ED). ED is the core center for pre-hospital and in-hospital emergency care. Because of the increasing demand for pre-hospital emergency services, independent pre-hospital emergency team has developed in 26 of 83 hospitals in Shenzhen. The pre-hospital emergency team consists of one doctor, one nurse and one driver. The doctor and nurse of the pre-hospital emergency team have to rotate every three months between ED and the team, except those aged >45 or with

health problem.^[9] The team should have knowledge of and be skilled in cardio-pulmonary resuscitation, intubation, automatic external defibrillation, bandaging and splinting, bleeding control and transfer procedures.

Apart from the daily emergency call from Shenzhen 120 EMS center, the pre-hospital emergency team is responsible for a) inter-facility transport of critically ill patients; b) social activities related medical support on standby; c) community emergency staff first-aid training; and d) disaster or group incident medical support. In Shenzhen, the average response time for ambulance dispatch (time from emergency call till ambulance departure) is 59 seconds from the pre-hospital emergency team.^[9]

Reasons of calling EMS

In 2011, the Shenzhen 120 EMS center received 153160 ambulance calls, with an average of 420 calls per day, which excluded 91 calls of wrong entry. In all of the calls, 63 693 were unclassified calls and excluded from the study.

In the classified (valid) ambulance calls ($n=89\,467$), 62.64% were related to male patients. Traumatic injury (46.62%) and general medical conditions (19.20%) go to a majority of the ambulance calls (Table 1). Table 2 illustrates the top ten reasons for calling the Shenzhen 120 EMS. Trauma due to traffic accident is the principal cause for calling ambulance service. The second and third causes are external wound or bleeding and syncope with loss of consciousness (LOC) respectively.

Adult patients aged 15–60 years, who are frequently seen in EMS, account for 84.20% of all the patients (Table 3). The main reasons for ambulance calls in adult

Table 1. The number of patients with ambulance calls classified by gender and category

Category of diseases	Male <i>n</i> (%)	Female <i>n</i> (%)	Total number of classified ambulance calls <i>n</i> (%)
Trauma	30 573 (34.17)	11 140 (12.45)	41 713 (46.62)
General	9 599 (10.73)	7 577 (8.47)	17 176 (19.20)
Poisoning	4 361 (4.87)	1 569 (1.75)	5 930 (6.63)
Gynecology & obstetric	0 (0.00)	4 348 (4.86)	4 348 (4.86)
Digestive	3 540 (3.96)	2 605 (2.91)	6 145 (6.87)
Cardiovascular	1 908 (2.13)	1 796 (2.01)	3 704 (4.14)
Neurovascular	1 690 (1.89)	1 072 (1.20)	2 762 (3.09)
Respiratory	1 137 (1.27)	965 (1.08)	2 102 (2.35)
Pediatric	780 (0.87)	461 (0.52)	1 241 (1.39)
Urology	670 (0.75)	251 (0.28)	921 (1.03)
Psychiatric	555 (0.62)	601 (0.67)	1 156 (1.29)
Suicide	440 (0.49)	627 (0.70)	1 067 (1.19)
Ear/nose/throat/eye/dental	286 (0.32)	146 (0.16)	432 (0.48)
Disaster incident	228 (0.25)	93 (0.10)	321 (0.36)
Oncology	146 (0.16)	86 (0.10)	232 (0.26)
Endocrine	107 (0.12)	82 (0.09)	189 (0.21)
Infectious	21 (0.02)	7 (0.01)	28 (0.03)
Grand total	56 041 (62.64)	33 426 (37.36)	89 467 (100.00)

Table 2. Top 10 causes for ambulance calling the Shenzhen 120 EMS

Rank	Causes for ambulance call (category)	Total number of classified ambulance calls <i>n</i> (%)
1	Traffic accident (trauma)	18 106 (20.24)
2	External wound / bleeding (trauma)	10 851 (12.13)
3	Syncope with loss of consciousness	8 492 (9.49)
4	Poisoning (poisoning)	5 930 (6.63)
5	Slip & fall (trauma)	5 152 (5.76)
6	Assault accident (trauma)	4 620 (5.16)
7	Dizziness / generalized fatigue	4 101 (4.58)
8	Abdominal pain (digestive disease)	3 875 (4.33)
9	Convulsion / epilepsy	2 415 (2.70)
10	Chest pain / heart disease	2 384 (2.66)

Table 3. The number of patients with ambulance calls classified by age and category

Category of diseases	Pediatric (0–14) <i>n</i> (%)	Adult (15–60) <i>n</i> (%)	Geriatric (>60) <i>n</i> (%)	Total number of classified ambulance calls <i>n</i> (%)
Trauma	1 839 (2.06)	37 553 (41.97)	2 321 (2.59)	41 713 (46.62)
General	596 (0.67)	13 791 (15.41)	2 789 (3.12)	17 176 (19.20)
Poisoning	152 (0.17)	5 687 (6.36)	91 (0.10)	5 930 (6.63)
Gynecology & obstetric	24 (0.03)	4 324 (4.83)	0 (0.00)	4 348 (4.86)
Digestive disease	77 (0.09)	5 359 (5.99)	709 (0.79)	6 145 (6.87)
Cardiovascular	25 (0.03)	2 176 (2.43)	1 503 (1.68)	3 704 (4.14)
Neurovascular	44 (0.05)	1 547 (1.73)	1 171 (1.31)	2 762 (3.09)
Respiratory	28 (0.03)	1 124 (1.26)	950 (1.06)	2 102 (2.35)
Pediatric	1 241 (1.39)	0 (0.00)	0 (0.00)	1 241 (1.39)
Urology	6 (0.01)	794 (0.89)	121 (0.14)	921 (1.03)
Psychiatric	22 (0.02)	1 073 (1.20)	61 (0.07)	1 156 (1.29)
Suicide	21 (0.02)	1 016 (1.14)	30 (0.03)	1 067 (1.19)
Ear/nose/throat/eye/dental	40 (0.04)	334 (0.37)	58 (0.06)	432 (0.48)
Disaster incident	14 (0.02)	299 (0.33)	8 (0.01)	321 (0.36)
Oncology	0 (0.00)	110 (0.12)	122 (0.14)	232 (0.26)
Endocrine	1 (0.00)	116 (0.13)	72 (0.08)	189 (0.21)
Infectious	1 (0.00)	25 (0.03)	2 (0.00)	28 (0.03)
Grand total	4 131 (4.62)	75 328 (84.20)	10 008 (11.19)	89 467 (100.00)

Table 4. Top three causes for ambulance calling the Shenzhen 120 EMS in different age groups

Reasons of calling (Category)	Pediatric (0–14) (n, %)	Adult (15–60) (n, %)	Geriatric (>60) (n, %)
Traffic accident (trauma)	1 006 (1.12)	16 537 (18.48)	0
Convulsion/epilepsy (pediatric)	616 (0.69)	0	0
External wound/bleeding (trauma)	393 (0.44)	10 156 (11.35)	0
Syncope with loss of consciousness	0	7 197 (8.04)	1 040 (1.16)
Slip & fall (trauma)	0	0	1 268 (1.42)
Dizziness/generalized fatigue	0	0	1 066 (1.19)
Grand total	4 131 (4.62)	75 328 (84.20)	10 008 (11.19)

patients are traffic accident (trauma) (18.48%), external wound or bleeding (trauma) (11.35%) and syncope with LOC (8.04 %). Geriatric patients (aged >60) next to the adult patients account for 11.19% of the patients who need EMS. In the geriatric patients, their ambulance calls are due to slip and fall (trauma), dizziness or generalized fatigue and syncope with LOC. The pediatric patients aged 0–14 account for 4.62% of the EM population. Apart from traffic accident (trauma), convulsion or epilepsy is the main cause for calling emergency services. Table 4 illustrates the top three causes for ambulance call in different age groups.

To better classify the causes for ambulance call by category, traumatic injury, general medical conditions and poisoning were the three major categories for ambulance call.

DISCUSSION

Life support for patients with trauma

In the causes for calling the Shenzhen 120 EMS center, traumatic injury due to traffic accident is common. This is similar to the situation in Zhengzhou^[10] and Shanghai.^[11] As in developed or developing countries, motor vehicle crashes (MVC) and falls are the predominant cause for traumatic injury. Roudsari et al^[12] reported that Austria has an incidence of 68% for MVC. In all patients receiving EMS, the average annual incidence of trauma ranges from 20% (Canada) to 37% (Iran) in developed and developing countries. Zhang et al^[13] also found that orthopedic injury is the major cause for hospitalization in Shenzhen. This indicates that after trauma life-support including fracture management is the essential element of professional training in pre-hospital emergency services in Shenzhen.

Although trauma care is required in ambulance

services, there is no officially recognized paramedic profession in China. The doctor, nurse, and ambulance driver are under the operation of ED. In the emergency team, the doctor and nurse are not required to have special training on pre-hospital care, nor post trauma life-support or periodical evaluation.^[14,15] Thus it significantly affects the quality of pre-hospital care and patient outcome.

Therefore, this study highlights the importance of basic life-support after trauma in EMS. Pre-hospital doctors and nurses should have specialized training on basic life-support after trauma such as primary and secondary head-toe assessment, cervical spine immobilization, fluid resuscitation, and en route patient management.

After initial stabilization on scene, the trauma patient should be directly transferred to the hospital nearby, preferably a designated trauma center. Apart from the necessity to improve pre-hospital trauma care, in-hospital trauma resuscitation collaboration is crucial to the enhancement of the EMS system. A well-structured emergency rescue network should be established between pre-hospital and in-hospital emergency support so as to provide appropriate medical care for the patient. The EMS system should focus on reducing the morbidity and mortality of patients by implementing the trauma standard 'platinum ten minutes' for pre-hospital response and transport and the 'golden hour' standard for trauma response to an appropriate hospital.^[16] In Australia, the fixed wing aircraft of the royal flying doctor service responsible for the "mantle of safety" in the management of orthopedic trauma in remote and rural area.^[17]

Government support for the development of EMS

On the other hand, government support for the development of pre-hospital emergency service is important. First, the pre-hospital emergency service should be provided by an independent paramedic profession. Second, a special training program should be given to paramedic personnel, who are qualified professionally and protected by the national emergency service law. Third, government policy and financial support will facilitate the development of pre-hospital care. In China, provincial and city bureaus of public health support the funding of the pre-hospital emergency service. The patient has to pay fee for ambulance and emergency treatment.^[4] In 2009, the national medical and health expenditure accounts for 6.98% of total expenditure, with an average of \$856.41 per head per year. In Shenzhen, the medical and health expenditure

also accounts for 4.85% of the total expenditure.^[18] To ensure a health and safe city in Shenzhen, the Ministry of Health should financially support the innovation in EMS, both in pre-hospital and in-hospital services. Capital investment, equipment procurement and training sponsorship are the important task in promoting the advancement of EMS.

Kalinowski^[16] listed the 15 mandatory components in the implementation of a completed EMS system: provision for manpower, training of personnel, communications, transportation, facilities, critical care units, use of public safety agencies, consumer participation, accessibility, transport of patients, keeping of standard medical record, consumer education and information, independent review and evaluation, disaster linkage, and mutual aid agreements. As a fast growing city, there is a need to design a universal standard EMS system. However, economic constraints and socio-political factors may be the essential determinants in the development EMS in developing countries.^[16]

Road traffic safety awareness

Traffic accidents are the target of pre-hospital emergency services. Government policies on traffic and driving ordinance should be legislated to protect the driver and public safety. In order to reduce the incidence of traffic accidents and release the burden to pre-hospital EMS service, public health injury prevention polices are required. A well-organized traffic control system and driver's driving behavior are the main concern. Besides, public education on road traffic safety is necessary.

Public education

This study shows that adult patients aged 15–60 years need EMS more particularly than other age groups in Shenzhen. This finding is quite different from that in Hong Kong and other countries.^[19] In Turkey, Keskinoglu^[20] reported that the utilization rate of pre-hospital EMS was approximately four times higher in the elderly than in the adult group. It can partly explain the unique characteristics of EMS in the mainland of China and their relations to the importance of public health education. Although EMS is adopted a "fee for service" system, inappropriate ambulance use still exists as a worldwide problem. A report revealed that only 25% of the population in urban areas in China have a medical insurance coverage.^[4] But the charging system cannot effectively inhibit the misuse of ambulance service. It is important for the medical authorities to educate the public on the proper use of EMS, first-aid care and

emergency response through mass media. Kalinowski^[16] suggested that "Public education is essential to assure appropriate access, utilization and injury prevention". For initial response, public health workers (rural) and public safety personnel (urban) are the first line of responders. Therefore, formal public health education and emergency care orientation are necessary. This study provides some clue to the health authorities in the planning, budgeting, training, and operation of EMS.

Limitations

Since the Shenzhen 120 EMS registry system is not a mature one, we reviewed only part of the data collected in Shenzhen. A standardized computerized registry system is necessary to reflect the true picture of EMS in Shenzhen. Apart from the demographic information, the data such as patient outcome, morbidity and mortality, length of hospitalization and admission rate are significant indicators for planning of pre-hospital and in-hospital services.

In conclusion, the EMS system in Shenzhen has its own characteristics. Traumatic injury and traffic accident are the main reasons for calling ambulance services. Adult patients call frequently EMS. To strengthen the emergency response network, paramedic personnel with specialized pre-hospital training and professional qualifications are needed. The collaboration between pre-hospital and in-hospital emergency trauma team support can foster the improvement of the emergency medical services system in Shenzhen.

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